Center Innovation Fund: ARC CIF

Methane Metabolism by Yeast

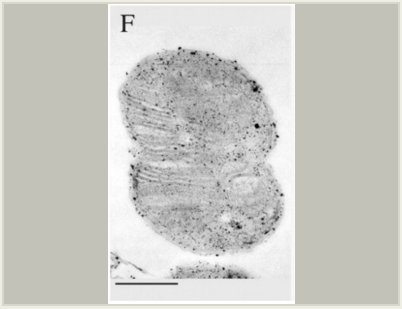
Completed Technology Project (2016 - 2017)

Project Introduction

Our Technical Approach is to move the soluble Methane Monooxygenase system (sMMO) from methanotrophic bacteria into Pichi). sMMO consists of a hydroxylase (MMOH) assembled from 3 polypeptides, a reductase (MMOR), and a regulatory protein (MMOB). Thus 5 genes must be introduced into Pichia to enable oxidation of methane to methanol. Methanol then enters the natural metabolism of Pichia. Methods for introducing genes into Pichia are well developed, and we will apply these techniques to introduce the genes of the sMMO system into Pichia. We will judge the success of our efforts by growing Pichia containing sMMO with methane as a sole carbon source and comparing this to control strains. We will also measure incorporation of 13C methane into biomass.

Anticipated Benefits

Producing materials in situ will reduce the mass that must be delivered from earth. CO2 is abundant on Mars and manned spacecraft. On the ISS, NASA reacts excess CO2 with H2 to generate CH4 and H2O using the Sabatier System (Fig 1). The resulting water is recovered into the ISS, but the methane is vented to space. Thus, there is a Capability Need for systems that convert methane into valuable materials. Methanotrophic bacteria consume methane but these are poor synthetic biology platforms. Thus, there is a Knowledge Gap in utilizing methane in a robust and flexible synthetic biology platform. The yeast Pichia pastoris is a refined microbial factory that is used widely by industry because it efficiently secretes products. Pichia could produce a variety of useful products in space. Pichia does not consume methane but robustly consumes methanol, which is one enzymatic step removed from methane. Our goal is to engineer Pichia to consume methane thereby creating a powerful methane-consuming microbial factory



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Ames Research Center (ARC)

Responsible Program:

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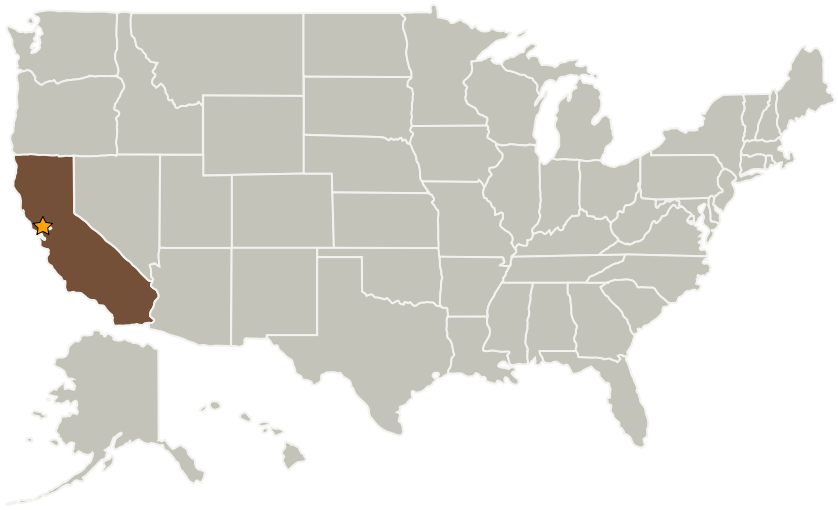
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Ames Research Center(ARC)	Lead Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations
California

Project Management

Program Director:
Michael R Lapointe

Program Manager:
Harry Partridge

Principal Investigator:
Jonathan M Galazka

Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.3 Resource Processing for Production of Mission Consumables

Target Destinations

Earth, Mars

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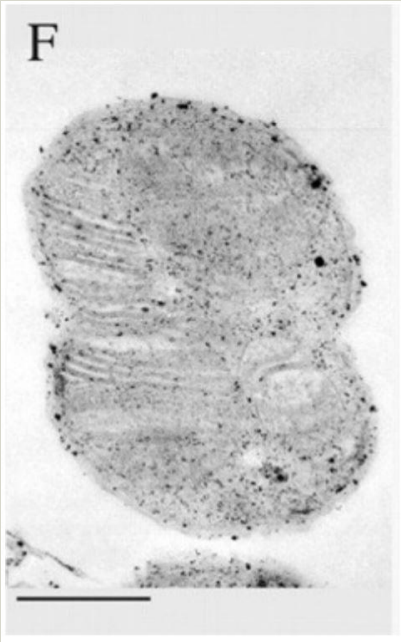
Images



Project Image
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(https://techport.nasa.gov/image/35776)